Chapter 4
Remedial Progress

The Agency's progress during FY93 illustrated its commitment to accelerating and completing cleanups at Superfund sites. The Agency started a record of nearly 120 remedial actions (RAs) to construct remedies, and completed construction activities to place 68 sites in the construction completion category. To date under the Superfund program, the Agency has completed clean-up activities to place a total of 217 National Priorities List (NPL) sites in the construction completion category.

This chapter describes the remedial process and provides information on

- FY93 progress in remediating NPL sites;
- Remedial initiatives;
- Remedies selected during the year;
- Efforts to develop and use innovative treatment technologies, including an evaluation of newly developed and achievable permanent treatment technologies, as required by CERCLA Section 301(h)(1)(D); and
- Sites requiring five-year reviews, under CERCLA Section 121(c), where contamination remained on site after remedial action was completed.

4.1 Remedial Process

The remedial process complements the removal process (see Chapter 3) by providing appropriate response for more complicated, long-term actions for our nation's highest-priority hazardous waste sites, those placed on the NPL. The process begins with the site evaluation phase, which consists of the discovery or identification of a potential site, the preliminary assessment of the site, and the site inspection (SI). During the SI, the site is evaluated for possible listing on the NPL. If a site is listed on the NPL after the SI, it is eligible for Trust Fund financing of clean-up activities under the remedial authority of CERCLA. Remedial activities include the following key components:

- The remedial investigation/feasibility study (RI/FS) to determine the type and extent of contamination, and evaluate and develop remedial clean-up alternatives;
- The record of decision (ROD) to identify the remedy selected, based on the results of the RI/FS and public comment on the clean-up alternatives;
- The remedial design (RD) to develop plans and specifications needed for the construction of the selected remedy;
- The RA to implement the selected remedy, including the start and completion of the construction; and
- Operation and maintenance (O&M) to assure the effectiveness and/or integrity of the remedy for long-term response actions.

A Remedial Project Manager (RPM) oversees all remedial activities and related enforcement activities. Regional Coordinators at EPA Headquarters assist RPMs by reviewing remedial and enforcement activities and answering technical or policy questions.

Acronyms Referenced in Chapter 4

ARAR	Applicable or Relevant and Appropriate Requirement
ATTIC	Alternative Treatment Technology Information Clearinghouse
BBS	Bulletin Board System
CA	Cooperative Agreement
CERCLIS	CERCLA Information System
CLU-IN	Clean-Up Information
DOE	Department of Energy
ERL	Environmental Research Laboratory
ETSC	Engineering Technical Support Center
MMTP	Monitoring and Measurement Technologies
NATO	North Atlantic Treaty Organization (NATO)
NPL	National Priorities List
O&M	Operation and Maintenance
ORD	Office of Research and Development
OSWER	Office of Solid Waste and Emergency Response
PCB	Polychlorinated Biphenyl
PRP	Potentially Responsible Party
RA	Remedial Action
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
RREL	Risk Reduction Engineering Laboratory
RTDF	Remedial Technologies Development Forum
SI	Site Inspection
SITE	Superfund Innovative Technology Evaluation
SSL	Soil Screening Level
START	Superfund Technical Assistance Response Team
STL	Superfund Technical Liaison
SVOC	Semi-Volatile Organic Compound
TIO	Technology Innovation Office
TSC	Technical Support Center
TSP	Superfund Technical Support Project
UST	Underground Storage Tank
VISITT	Vender Information System for Innovative Treatment Technologies
VOC	Volatile Organic Compound

4.2 Fiscal Year 1993 Progress

The Agency's progress during the fiscal year in initiating RAs and completing construction activities to classify sites as construction completion, indicates its continued commitment to accelerate the clean up of NPL sites. By the end of FY93, work had occurred at 94 percent of the 1,320 NPL sites. Sites deleted from the NPL reflect an activity required to be reported. Exhibit 4.2-1 illustrates the status of the work at NPL sites, showing sites by the most advanced stage of activity accomplished. The following sections of this report highlight progress made at the sites during FY93.

4.2.1 Construction Completion

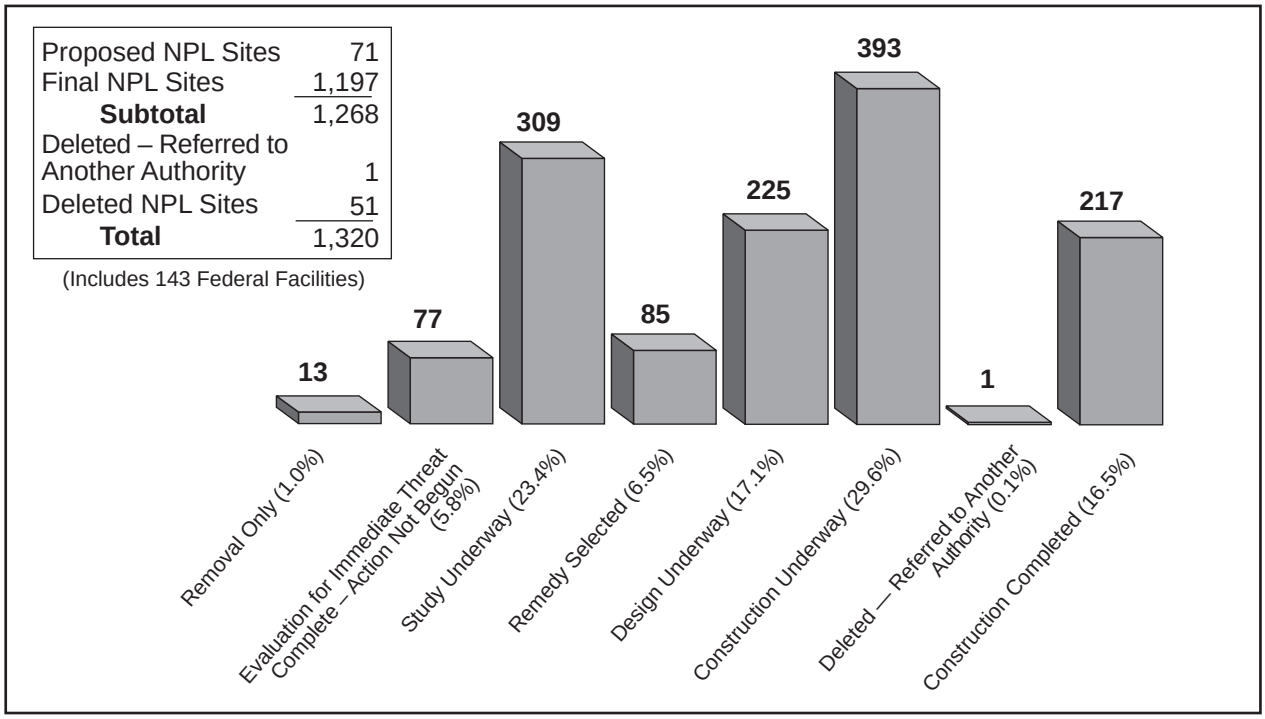
In response to the recommendations of the 1991 30-Day Study, the Agency has worked to accelerate and complete cleanup at NPL sites. The Agency completed construction activities to bring the total number of sites in the construction completion category to 217 by the end of the fiscal year, exceeding the recommended FY93 target of 200. This total includes 68 sites that achieved classification as construction completion during FY93. Nearly 72 percent of the sites classified as construction completion have achieved that status during the past two years; this achievement illustrates the Agency's commitment to accelerating and completing clean up of Superfund sites.

4.2.2 New Remedial Activites

As shown in Exhibit 4.2-2, the Agency or potentially responsible parties (PRPs) had undertaken approxitmately 1,600 RI/FSs, 1,120 RDs, and 730 RAs under the Superfund program by the close of the fiscal year. The remedial progress achieved by the Agency during FY93 reflects the Agency's efforts to accelerate the pace of cleanup by emphasizing the initiation and completion of remedy construction at sites. In comparison to previous fiscal years, the emphasis on completing sites has resulted in a record number of new RAs to construct remedies at sites, and decreases in the number of new, earlier stage, RDs and RI/FSs. New remedial activities undertaken this fiscal year include

- *RI/FS Starts:* EPA initiated more than 30 RI/FSs during FY93, and PRPs started more than 20, or 40 percent, for a total of nearly 60 RI/FSs started during the fiscal year. In comparison, EPA and PRPs each started 50 percent of nearly 90 RI/FSs in FY92.
- *RD Starts:* The Agency or PRPs started approximately 130 RDs during FY93, including 40 financed by EPA and 90 (65 percent) financed

Exhibit 4.2-1
Work Has Occurred at 94 Percent of the National Priorities List Sites



Source: CERCLIS. 51-037-1D

by PRPs. During FY92, the Agency or PRPs started approximately 170 RDs, including 50 financed by EPA and 120 financed by PRPs.

- *RA Starts:* The Agency or PRPs started nearly 120 RAs during FY93; EPA financed 30 and PRPs financed 90, or approximately 80 percent. During FY92, the Agency or PRPs started approximately 110 RAs, including 30 financed by EPA and 80 financed by PRPs.

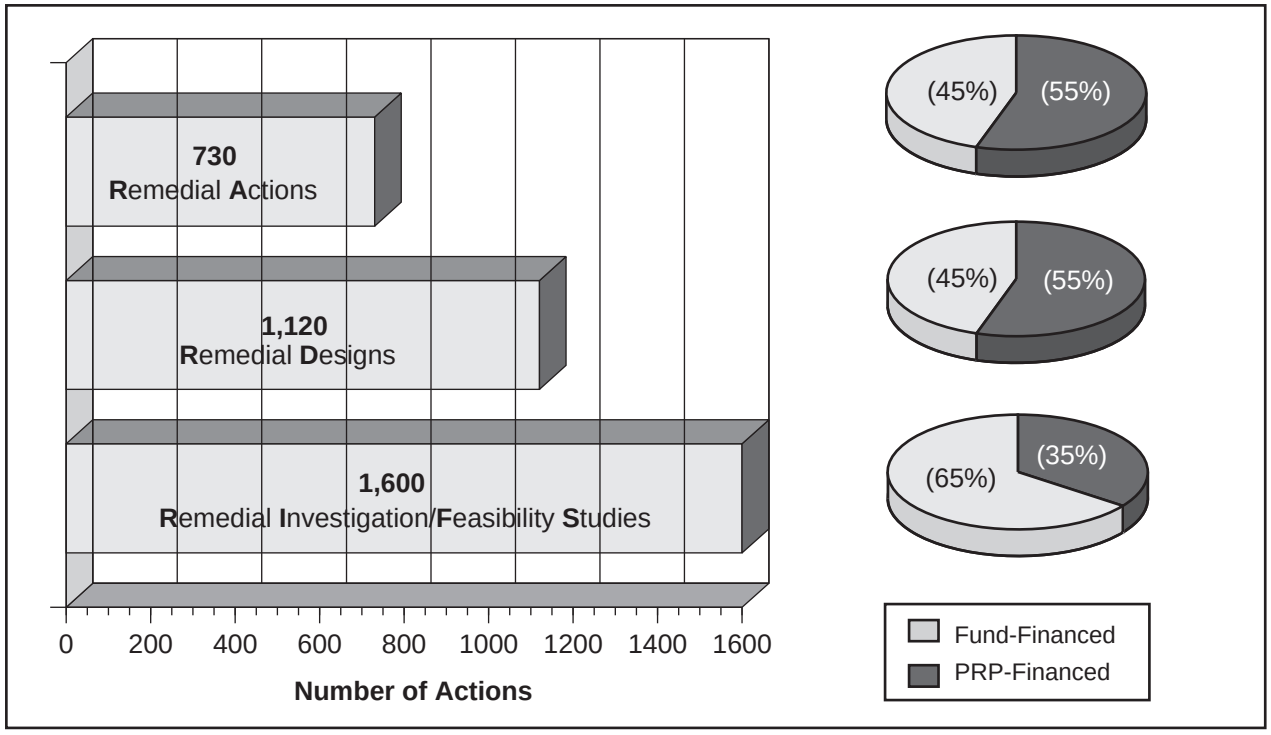
4.2.3 Status of Remedial and Enforcement Activities in Progress

At the end of FY93, 1,305 RI/FS and RA projects were in progress at 727 NPL sites, compared with 1,274 RI/FS and RA projects at 751 NPL sites at the end of FY92. FY93 projects included 919 RI/FSs and 386 RAs. As required by CERCLA Sections 301(h)(1)(B), (C), and (F), a listing of the projects in progress at the end of FY93 is provided in Appendix A, along with a projected completion schedule for each project. There were also 445 RDs in progress at the end of FY93, compared with 412 RDs in progress at the end of FY92. A listing of all RDs in progress at the end of FY93 is provided in Appendix B.

Of the 1,305 RI/FS and RA projects in progress at the end of FY93, 61 percent were on schedule, ahead of schedule, started during the fiscal year, or had no previously published completion schedule, and 39 percent were behind schedule. These projects include 423 on schedule, 40 ahead of schedule, 259 started during the fiscal year, 71 that had no previously published completion schedule, and 512 that were behind schedule. Exhibit 4.2-3 compares the number of projects in progress at the end of FY92 and FY93 at NPL sites, by lead.

PRPs were conducting 471 of the RI/FS and RA projects in progress at the end of FY93, including 264 RI/FS and 207 RAs. Of these 471 PRP-financed

Exhibit 4.2-2
Remedial Accomplishments Under the Superfund Program for Fiscal Year 1980 Through Fiscal Year 1993



Source: CERCLIS.

51-037-18

projects, 62 percent were on schedule, ahead of schedule, started during the fiscal year, or had no previously published completion schedule, and 38 percent were behind schedule. Projects include 146 on schedule, 14 ahead of schedule, 106 started during the fiscal year, 26 that had no previously published completion schedule, and 179 that were behind schedule.

The status of RI/FSs and RAs in progress at the end of the fiscal year is based on a comparison of each project's planned completion date in the CERCLA Information System (CERCLIS) at the end of FY92 with the planned completion date in CERCLIS at the end of FY93. An initial completion schedule is included when a remedial activity is entered into CERCLIS. Minimal site-specific information is available when the initial completion schedule is determined by the Regions, and they usually rely on standard planning assumptions (e.g., 12 quarters for an RI/FS). As work continues, Regions adjust schedules for projects to reflect actual site conditions.

4.3 REMEDIAL INITIATIVES

The 1993 Administrative Improvements Task Force recommended continuing several efforts initiated under the 30-Day Study to streamline remedial activities and increase consistency and efficiency in the Superfund program. The three primary efforts were developing presumptive remedies, establishing soil screening levels, and developing guidance on the technical impracticability ARAR waiver.

Presumptive Remedies

As part of the administrative improvement

Exhibit 4.2-3
Projects in Progress at National Priorities List Sites by Lead for Fiscal Year 1992 and Fiscal Year 1993

	RI/FS		RDs		RAs	
	FY92	FY93	FY92	FY93	FY92	FY93
Fund-Financed—State-Lead	37	28	22	25	29	26
Fund-Financed—Federal-Lead[1]	153	145	104	107	105	95
Fund-Financed—EPA Performs Work at Site[2]	15	21	4	4	2	3
PRP-Financed and PRP-Lead	259	219	233	238	151	186
Mixed Funding—Monies from Fund and PRPs	2	0	3	1	7	9
PRP-Financed—State Order and EPA Oversight[3]	51	45	15	23	20	21
State Enforcement	3	2	0	1	0	0
Federal Facility	400	459	31	46	40	46
Total	**920**	**919**	**412**	**445**	**354**	**386**

[1] Includes remedial program-lead projects and enforcement program-lead projects.
[2] Projects at which EPA employees, rather than contractors, perform the site clean-up work.
[3] Projects where site clean-up work is financed and performed by the PRPs under state order, with EPA oversight.

Sources: *Progress Toward Implementing Superfund:* FY92 (Appendices A and B) and FY93 (Appendices A and B). 51-037-25

initiative, the Agency is continuing to develop presumptive remedies to streamline the remedy selection process for certain categories of sites. On September 30, 1993, the Agency issued directives on presumptive remedies for municipal landfill sites and sites with soil contaminated with volatile organic compounds (VOCs). The Agency also issued a directive on policies and procedures for using presumptive remedies.

Additional presumptive remedies directives are being developed for wood treater, polychlorinated biphenyl (PCB), manufactured gas plant, grain storage, and ground-water sites. The Office of Research and Development (ORD) supported the development of the presumptive remedies by providing a technical basis for identifying remedies for these categories of sites.

To trial test the use of presumptive remedies, the Agency selected sites to demonstrate presumptive remedies for municipal landfills and soil contaminated with VOCs. Demonstrations are also planned for other categories of presumptive remedies.

Soil Screening Levels

The effort to develop soil screening levels (SSLs) continued under the administrative improvements initiative. The Agency issued a draft guidance on SSLs on September 30, 1993, following a review by EPA Regional offices. The guidance was issued to the public in draft form to facilitate discussion with all parties that might be interested, such as states, environmental groups, and financial lending institutions. The Agency will also publish a revised draft in the *Federal Register* to solicit further comment.

The draft SSL guidance proposed threshold levels of chemical concentrations in soil that would generally

warrant site-specific study of risks. Levels above the screening level would not automatically trigger remedial action, or cause a site to be designated as "contaminated," but further evaluation of the site would be required. Generally, where chemical concentrations fall below the SSL, no further action or study would be required.

Guidance on the Technical Impracticability ARAR Waiver

Guidance issued October 4, 1993, provides a consistent process for invoking the technical impracticability ARAR waiver. The requirement for meeting ARARs may be waived when they cannot be attained using available technology. The waiver is invoked primarily at ground-water sites, particularly sites that may be contaminated with dense non-aqueous-phase liquids (DNAPLs). The waiver can be invoked before the ROD is signed if sufficient supporting data is provided. Typically, the waiver is invoked following implementation of a ground-water remedy, after performance monitoring data are available.

The guidance stresses the need to develop alternative remedial strategies where maximum contaminant levels or other requirements cannot be reached. Alternative strategies may establish less stringent goals, a limited area of restoration, or containment. The guidance incorporates a phased approach to ground-water restoration, where limited systems are implemented early to stop plume migration and test the practicability of restoration, after which a final remedy decision will be made.

4.4 Remedy Selection

The Agency signed 190 RODs in FY93, including 134 new and amended RODs for PRP-financed and Fund-financed sites and 56 RODs for federal facility sites.

The ROD documents the results of all studies performed on the site, identifies each remedial alternative that the Agency considered, and explains the basis for selecting one of them as a remedy. The ROD is signed after completion of the RI/FS and after the public has had the opportunity to comment on the remedial alternatives under consideration. The Agency selected a variety of remedies in FY93 year RODs, based on a careful analysis of characteristics unique to each site and the proximity of each site to people and sensitive environments. (Wetlands and endangered wildlife are examples of environmental resources that are taken into consideration when evaluating remedies.)

Congress, with the enactment of SARA, sent EPA a clear message to give preference to treatment rather than containment remedies. Exhibit 4.4-1 lists the number and types of source-control treatment and containment remedies selected in FY93 RODs. It also identifies the number of remedies selected for addressing contaminated ground water. Exhibit 4.4-2 represents the 190 FY93 RODs by percentage comparison based on the type of remedies selected. Exhibit 4.4-3 represents the distribution of treatment and containment remedies selected in the 190 FY93 RODs.

The list of the 190 RODs signed during FY93 is provided in Appendix C. To fulfill the requirement of CERCLA Section 301(h)(1)(A) to provide an abstract of each feasibility study (e.g., ROD), a summary of each ROD has been published in the *ROD Annual Report : FY 1993.*

4.5 Use and Development of Treatment Technologies

In each year since the enactment of SARA, more than 70 percent of the RODs have contained provisions for the treatment of wastes. To promote the use of innovative treatment technologies and to satisfy the CERCLA requirement for preference of treatment remedies, EPA's Office of Solid Waste and Emergency Response (OSWER) and ORD established the Superfund Innovative Technologies Evaluation (SITE) program, administered by ORD. ORD has also established six technical support centers (TSCs) to increase the speed and quality of Superfund cleanups, reduce clean-up costs, address technical

Exhibit 4.4-1
Summary of Remedies Selected in Fiscal Year 1993 Records of Decision[1]

Source Control Remediation	Occurrences
Treatment Technologies	
Immobilization	25
In Situ Vacuum/Vapor Extraction	19
Incineration/Thermal Destruction	14
To Be Determined/Unspecified Treatment Technologies	13
Bioremediation	13
Thermal Desorption	10
Air Sparging	2
Soil Flushing	2
Volatilization/Aeration	1
Dechlorination	1
Soil Washing	1
In Situ Vitrification	0
Solvent Extraction	0
Chemical Treatment	0
Total	**101**
Other Treatment	
Decontamination	11
Recycling/Recovery	10
Surface Water Treatment	7
NAPLs Treatment	8
Gas Flaring	6
Total	**42**
Containment Only	
On Site	25
Off Site	11
Total	**36**
Other Actions (e.g., Institutional Controls, monitoring)	4

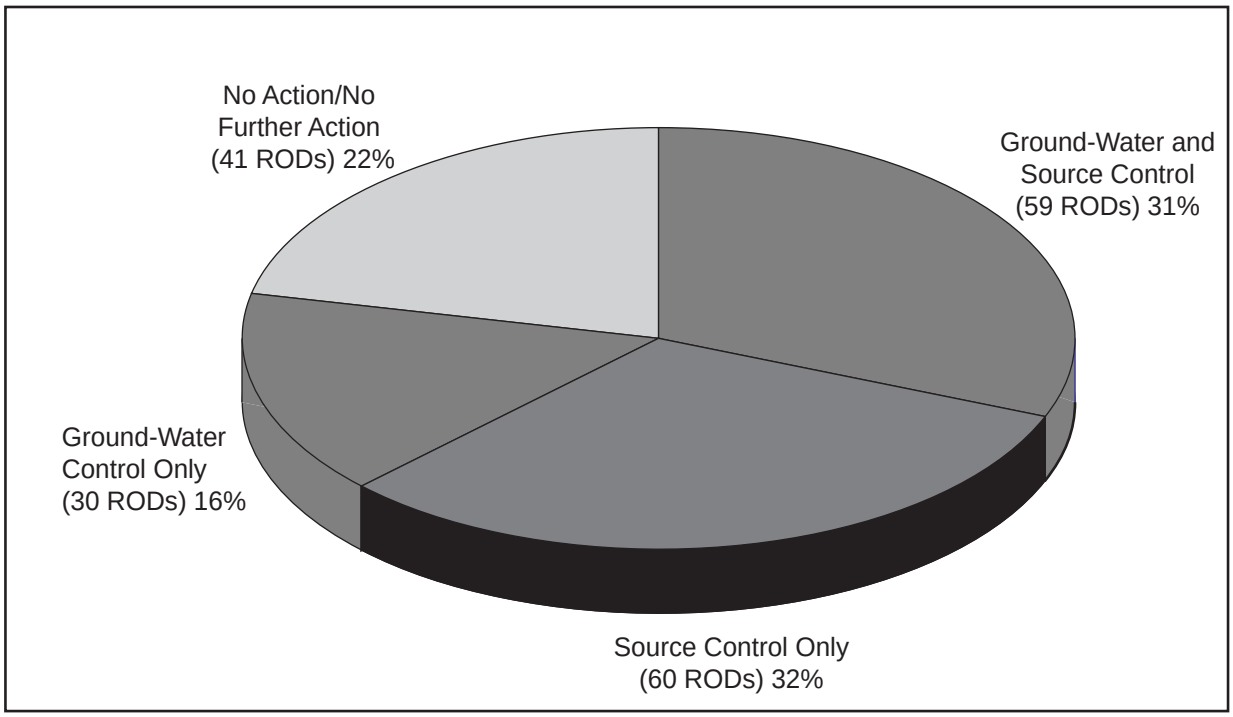
Contaminated Ground-Water Remediation	Occurrences
Ground-Water Treatment	
Physical	
Air Stripping	31
Carbon Adsorption	18
Filtration	16
Oil/Water Separation	8
Air Sparging	3
Aeration	2
Steam Stripping	1
Chemical	
Chemical/Physical	1
Coagulation/Flocculation	3
Electrochemical Reduction	1
In Situ Oxidation	1
Ion Exchange	4
Neutralization (pH Adjustment)	5
Publicly Owned Treatment Works	15
Precipitation	11
Reduction/Oxidation	4
Sedimentation/Clarification	6
UV/Oxidation	1
Waste Water Treatment Plant	1
Other Treatments	
To Be Determined/Unspecified Treatment Technologies	15
Bioremediation (*In Situ/Ex Situ*)	3
Total	**150**
Other Remedies	
Natural Attenuation	16
Plume Management	10
Alternate Water Supply	8
Leachate Treatment	8
Other Ground-Water Actions (Institutional Controls, Monitoring)	6
Total	**48**

[1]Based on 190 FY93 RODs, including 56 federal facility RODs. More than one remedy may be associated with a ROD.

Source: Office of Emergency and Remedial Response/Hazardous Site Control Division.

51-037-36A

Exhibit 4.4-2
Percentage Distribution of Remedies Selected
In Fiscal Year 1993 Records of Decision



Source: EPA Hazardous Site Control Division.

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issues encountered in site cleanup, and provide the Regional Superfund staff with technical resources. ORD also supports information transfer activities, including seminars, bulletins, and computer systems, and supplies technical assistance to the federal, state, and public sectors in evaluating potentially applicable treatments.

For Superfund, the Technology Innovation Office (TIO) has the responsibility of encouraging the use of innovative technologies. TIO uses booklets, journals, databases, and conferences to alert project managers, engineers, academics, contractors, and other interested parties to the availability of new technologies.

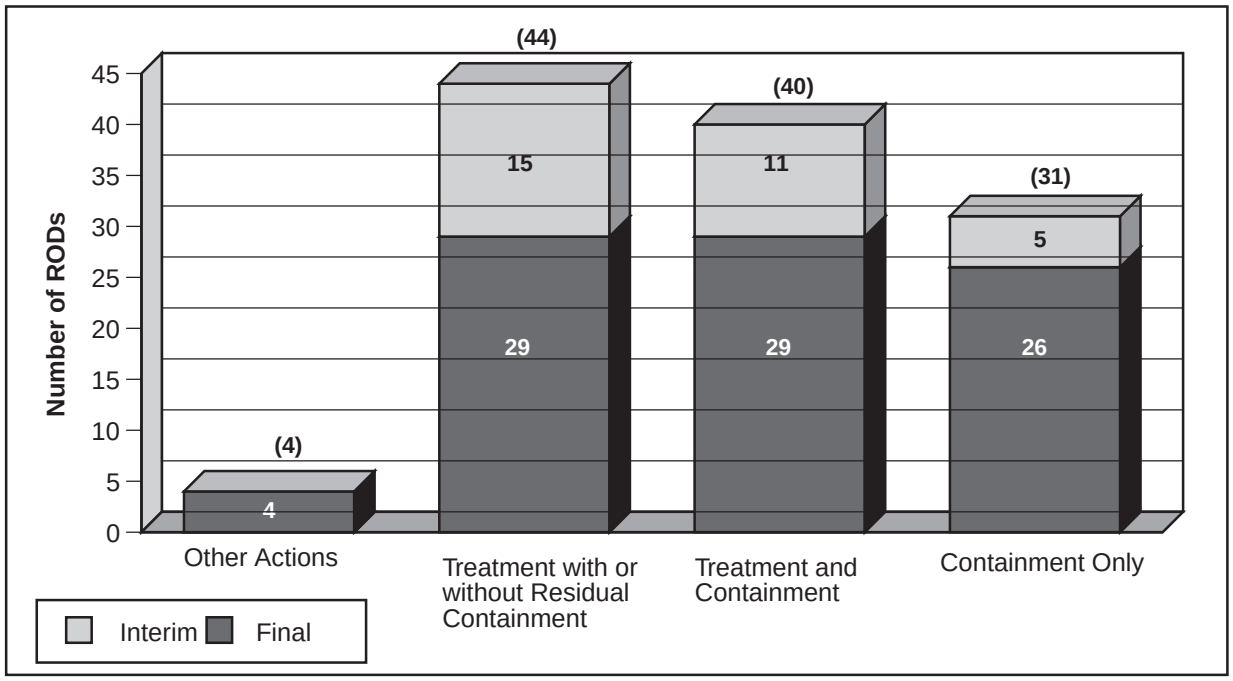
Within the Agency, TIO works with other offices to affect policy change, assists the implementation of demonstrations of technologies under the SITE program, analyzes trends in technology application, identifies vendors and remediation markets, and champions innovative technologies within EPA. Outside EPA, TIO works with interested parties to identify opportunities for increased collaboration in developing technologies.

4.5.1 Superfund Innovative Technology Evaluation Program Progress

To promote the use of innovative treatment technologies and to satisfy the CERCLA requirement for preference of treatment remedies, OSWER and ORD established the SITE program. ORD's Risk Reduction Engineering Laboratory (RREL), headquartered in Cincinnati, Ohio, administers the SITE program. The goals of the program are the development, demonstration, and subsequent application of new innovative treatment technologies. As part of this program, ORD invites technology developers to demonstrate new, innovative technologies for waste from NPL sites.

The SITE program, in its eighth year as of FY93, has been an integral part of EPA's research into

Exhibit 4.4-3
Distribution of Treatment and Containment Remedies Selected in Fiscal Year 1993 Records of Decision



Source: EPA Hazardous Site Control Division

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alternative clean-up methods for hazardous waste sites. Under the program, EPA awards cooperative agreements (CAs) to technology developers. These developers then refine a technology during bench- or pilot-scale tests. With support from EPA, developers may also demonstrate a technology in the field at a hazardous waste site. EPA collects and publishes engineering, performance, and cost data on the technologies tested through the program to inform future decision making for remediation of hazardous waste sites.

EPA's analysis of technologies tested under the SITE program indicates that innovative treatment technologies provided a cost savings as compared to standard remedial treatments. For example, Exhibit 4.5-1 illustrates an analysis of 17 RODs where remedial technologies under the SITE program were tested. The average cost savings for innovative treatment technology versus standard treatment per site was $21 million dollars or 62 percent.

The successful implementation of innovative technologies requires a team approach. Accordingly, SITE program staff members work closely with EPA's Regional offices, states, technology developers, the Superfund Technical Assistance Response Team (START), and OSWER to provide technology demonstrations and to disseminate information. The SITE program also uses EPA research facilities, such as the Test and Evaluation Facility and the Center Hill Facility in Cincinnati, Ohio, to evaluate innovative technologies.

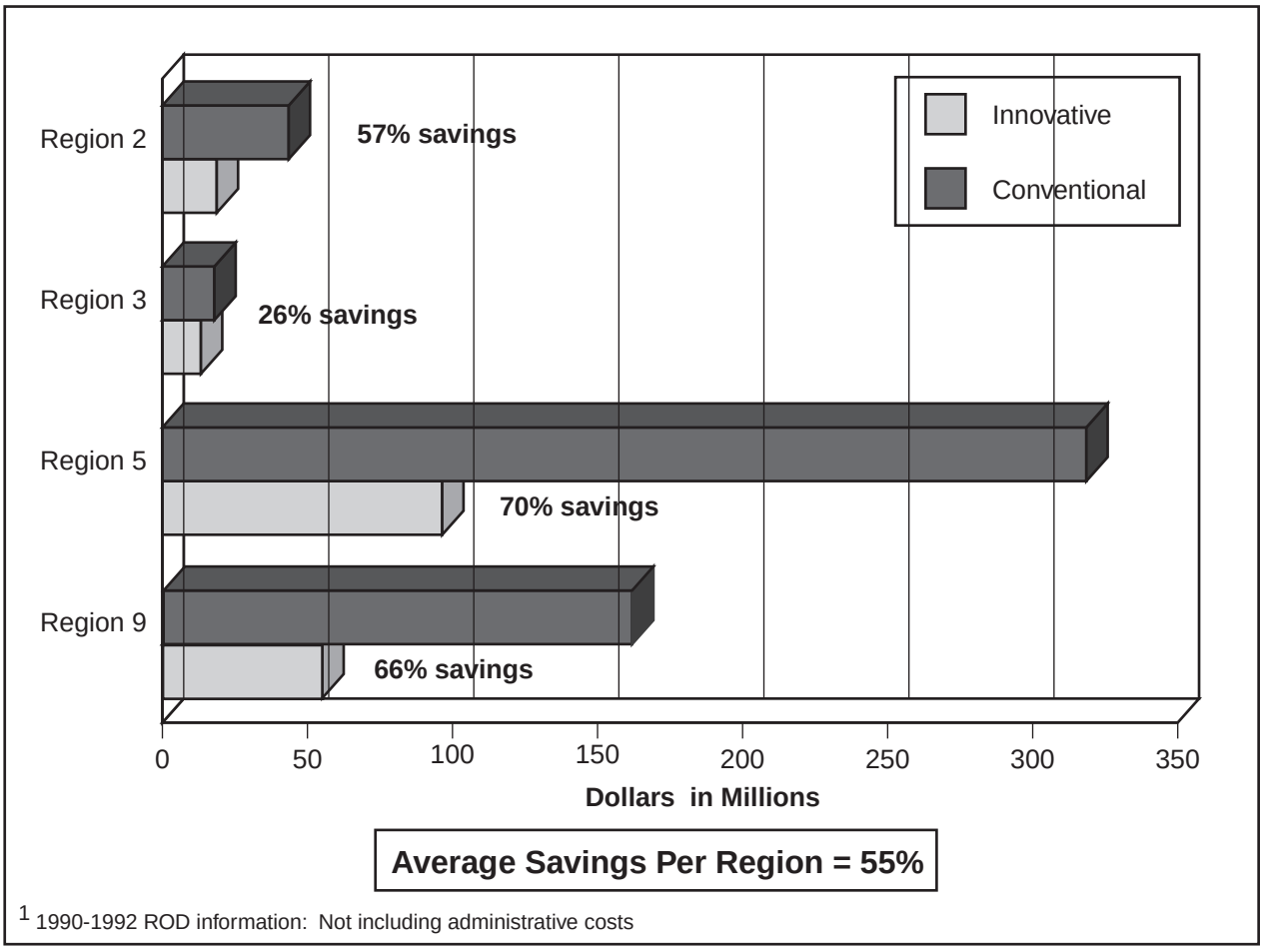
Operational Areas

The SITE program is divided into four operational areas: emerging technologies, demonstrations, monitoring/measurement, and technology transfer.

Emerging Technologies Program

EPA provides technical and financial support to developers for bench- and pilot-scale testing and evaluating of innovative technologies that have been, at a minimum, proven on the conceptual or bench-

Exhibit 4.5-1
Cost Savings with Innovative Technologies[1]



[1] 1990-1992 ROD information: Not including administrative costs

Source: Office of Research and Development

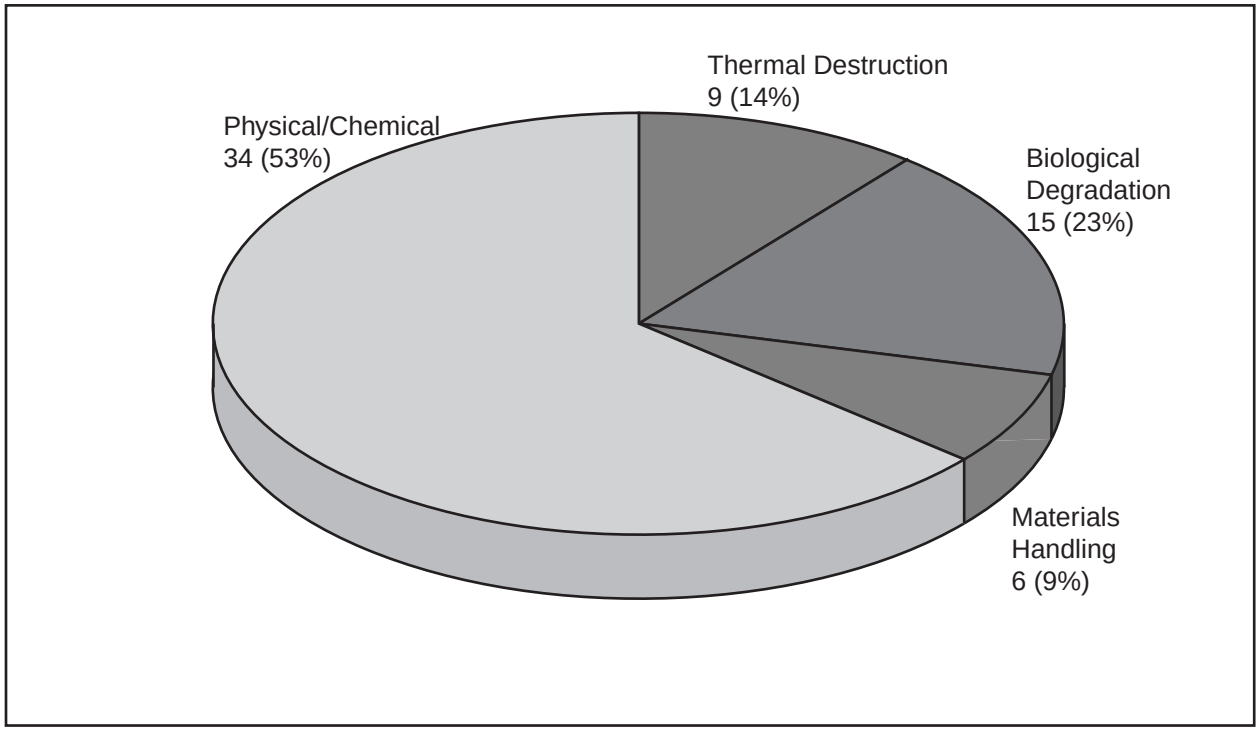
51-037-23B

scale level. EPA's intent is to advance these technologies to the more rigorous testing of the Demonstration Program after initial testing. Under the Emerging Technologies Program, the applicability of particular technologies to Superfund site waste characteristics is evaluated. Each technology's performance is documented in a final report, project summary, and bulletin. In response to the FY92 solicitation, 11 new technologies were accepted in the Emerging Technologies Program in FY93, bringing the total number to 64. Exhibit 4.5-2 provides a percentage breakdown, by treatment technique, of the technologies tested in the Emerging Technologies Program through FY93.

Demonstration Program

Promising innovative technologies are field-tested on hazardous waste materials. Engineering and cost data are gathered on the technologies so that potential users can assess their applicability to the cleanup of a particular site. Data collected during the field demonstration are used to assess the performance of the technologies, the potential need for pre- or post-processing of the waste, application to types of wastes and waste matrices, potential operating problems, and approximate capital and operating costs. During FY93, 15 new technologies were accepted into the Demonstration Program, including 4 from the annual request for proposals, 2 from the

Exhibit 4.5-2
Innovative Technologies in the Emerging Technology Program



Source: Office of Research and Development.

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Emerging Technologies Program, 1 from nominations by EPA Regional offices and other federal agencies, and 8 from other sources. As of December 1993, the program included 98 technology projects, 8 of which were demonstrated in FY93. Exhibit 4.5-3 provides a percentage breakdown by treatment technique of technologies in the Demonstration Program as of the end of FY93. A description of the eight demonstrations conducted in FY93 is provided later in this chapter.

Monitoring and Measurement Technologies Program (MMTP)

The goal of this program is to assess innovative and alternative monitoring, measurement, and site characterization technologies. During FY93, demonstrations of six technologies were conducted; each demonstration included one or more monitoring and measurement techniques.

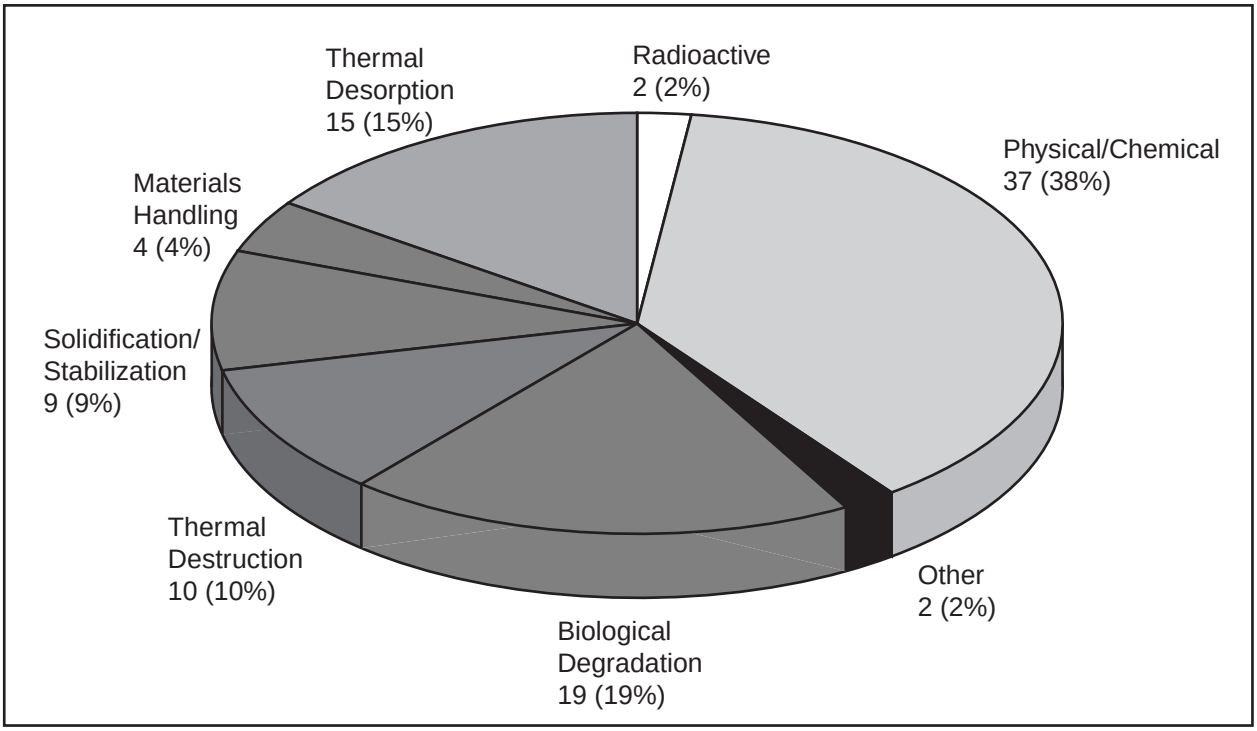
Technology Transfer Program

Technical information on innovative technologies in the Emerging Technologies Program, Demonstration Program, and MMTP is disseminated through various activities. The Agency provides this information to increase the awareness and promote the use of innovative technologies for assessing and remediating Superfund sites, and to encourage communication among individuals who require up-to-date technical information.

Fiscal Year 1993 Demonstrations of Innovative Treatment Technologies

To evaluate new treatment technologies, developers completed 8 field demonstrations during FY93, bringing the total number of demonstrations that have been completed under the SITE Demonstration Program to 57. The demonstrations completed in FY93 are summarized below.

Exhibit 4.5-3
Innovative Technologies in the Demonstration Program



Source: Office of Research and Development.

51-037-32

GIS/Solution, Inc. developed GIS/Key, a comprehensive, menu-driven environmental database management system. GIS/Key consists of six modules that facilitate collecting, reporting, and analyzing electronic site data. The system can produce maps, graphs, tables, and backlogs that are designed to meet CERCLA and RCRA reporting requirements. The use of this automated system for site data will result in significant labor and cost savings. The technology was accepted into the SITE demonstration program in summer 1992 and demonstrated in San Francisco, California, in August 1993.

Hughes Environmental Systems, Inc.'s Steam-Enhanced Recovery Process removes most VOCs and semivolatile organic compounds (SVOCs) from contaminated soil both above and below the water table. The process accelerates contaminant removal rates and can be effective in all types of soil. Using injection wells, it forces steam through the soil to thermally enhance the recovery process. Extraction wells pump and treat the ground water and then transport vaporized contaminants to the surface. Recovered nonaqueous liquids are separated, hydrocarbons are collected for recycling, and vapors are condensed and treated. The demonstration of this technology began in August 1991 and was completed in September 1993 in Huntington Beach, California.

Magnum Water Technology's CAV-OX process uses a synergistic combination of hydrodynamics, cavitation, and ultraviolet radiation to oxidize organic contaminants in ground water or waste water. The process is designed to remove the contaminants without releasing gaseous VOCs. Treatment costs are estimated to be about half that of advanced ultraviolet oxidation systems and substantially less than carbon absorption. Maintenance costs are also minimal because the equipment used in the process has only one moving part. This technology, which was accepted into the demonstration program in summer 1992, was demonstrated in March 1993 at Edwards Air Force Base in Edwards, California.

EPA RREL developed a process to remediate soil and sediment contaminated with chlorinated organic compounds. Through the base-catalyzed

dechlorination process, chemicals are mixed with the contaminated matrix and then heated. The process strips off chlorine from PCBs or other halogenated material. Off-gases are then treated and released. The technology was demonstrated at the Koppers site in Morrisville, North Carolina, in August 1993.

The Illinois Institute of Technology/Halliburton NUS developed radio frequency (RF) heating, an *in situ* process that uses electromagnetic energy to volatilize organic contamination in soil. The RF heating technology can heat soil to temperatures up to 600 degrees Celsius using electrodes embedded in the soil. Contaminants are then removed by conventional soil-vapor extraction methods, and the vapors are treated with existing technologies. The RF heating process was accepted into the SITE demonstration program in summer 1992. It was demonstrated at the Kelly Air Force Base in San Antonio, Texas, during summer 1993 as part of a joint project with the U.S. Air Force.

Filter Flow Technology, Inc.'s colloid sorption method is a polishing-filter process that removes ionic colloidal, complexed, and chelated heavy-metal radionuclides from ground water, pond water, and industrial waste water. The technology involves pumping and treating the contaminated water and chemically conditioning it in mixing tanks. Treatment systems have been designed for application in both mobile field equipment and fixed installations. The technology, which was accepted into the SITE demonstration program in July 1991, was demonstrated at Rocky Flats in Golden, Colorado, in September 1993.

Hrubetz Environmental Services, Inc.'s HRUBOUT™ process is a thermal *in situ* treatment process that removes VOCs and SVOCs from contaminated soil. Heated air is injected into the soil below the zone of contamination, evaporating the soil moisture and removing volatile and semivolatile hydrocarbons. Non-volatiles are removed by slow oxidation at high temperature ranges. The technology was accepted into the SITE demonstration program in July 1992. The process was demonstrated at the Kelly Air Force Base in San Antonio, Texas, in January and February 1993.

Eli Eco-Logic International, Inc. developed the Eco-Logic Process, which uses a gas-phase reduction reaction of hydrogen with organic and chlorinated-organic compounds at high temperatures to convert aqueous and oily hazardous contaminants into a hydrocarbon-rich gas product. The gas product's primary components are hydrogen, nitrogen, methane, carbon monoxide, and water vapor. The demonstration of this technology was conducted at the Middleground Landfill in Bay City, Michigan, in October and November 1992.

4.5.2 Superfund Technical Assistance Programs

To provide multi-disciplinary technical support to Superfund cleanups, the Agency sponsors the ORD TSCs, START, and Superfund Technical Liaisons (STLs) and the Ground-Water and Engineering Forums. The goals of these technical assistance programs are to increase the speed and quality of Superfund cleanups, reduce clean-up costs, address technical issues encountered in site cleanup, and provide the Regional Superfund staff with direct access to the technical expertise and resources of the Agency's active researchers.

Technical Support Centers and Superfund Technical Assistance Response Teams

In FY93, OSWER funded six ORD laboratories as TSCs to provide site-specific assistance in the areas of ground-water remediation, risk assessment, engineering, site characterization, radiological evaluation, and modeling. The six TSCs include five administered by ORD (the Environmental Monitoring Services Laboratory, RREL, the Robert S. Kerr Environmental Research Laboratory (ERL), Athens ERL, and the Environmental Criteria and Assessment Office) and one administered by the Office of Radiation and Indoor Air (the National Air and Radiation Environmental Laboratory). During the year, the six TSCs responded to over 550 requests for assistance from RPMs and other Regional technical staff. The responses ranged from treatability studies, technical reviews of proposals, toxicity studies, and radiological and model evaluation.

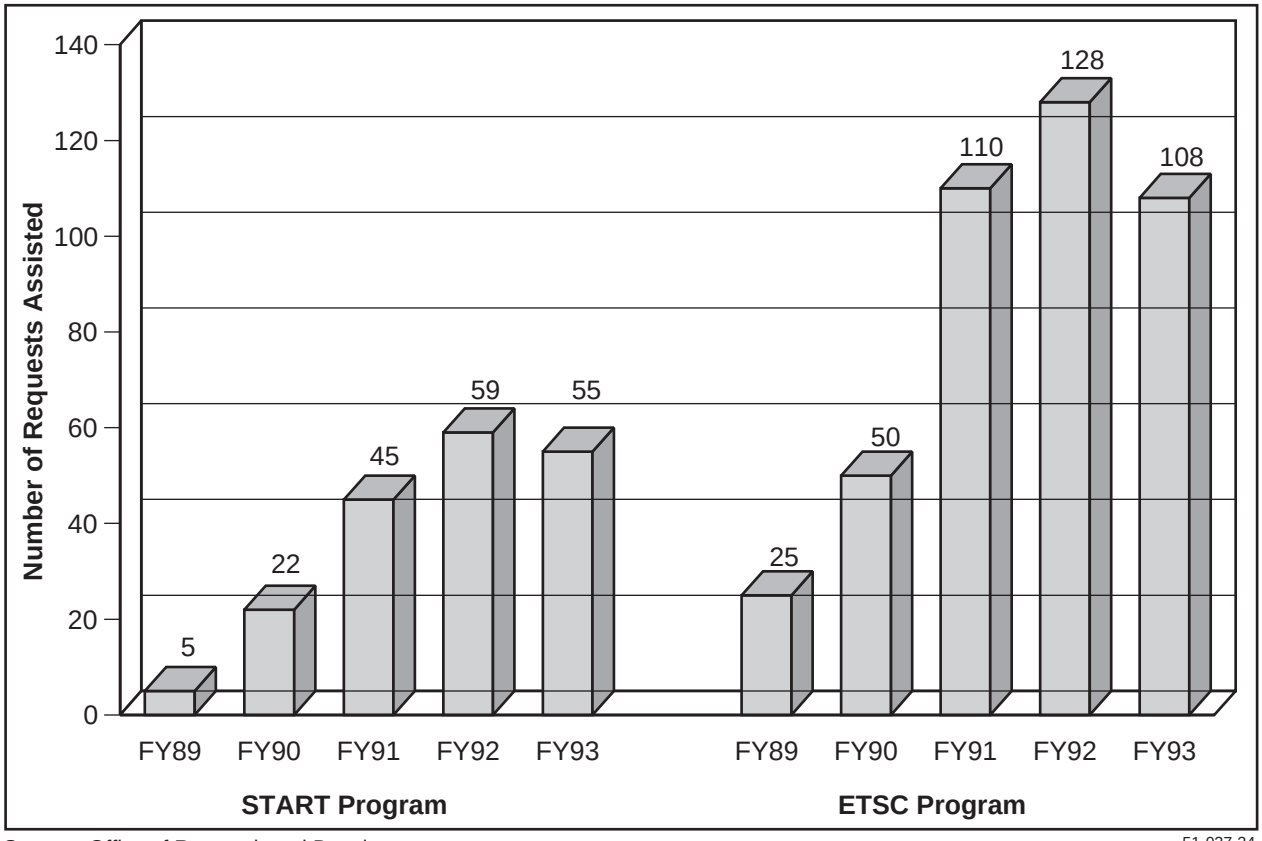
The increasing use of the TSCs and the Superfund Technical Assistance Response Team (START), which is designed to provide long-term intensive engineering assistance to Regional staff, is illustrated by the increasing number of requests received by the centers. For example, Exhibit 4.5-4 shows the significant increase in the number of requests received by the Engineering Technical Support Center (ETSC) and START since FY89. Other support centers experienced similar increases during these years; requests made to the Robert S. Kerr ERL TSC increased from 56 in FY89 to 132 in FY93.

In addition to responding to Regional requests for assistance, the TSCs worked jointly with the Engineering and Ground-Water Forums to publish issue papers on the remediation of PCBs, remediation of light non-aqueous phase liquids, use of pump and treat technologies, and use of *in situ* soil treatment. To address issues and problems in ground-water sampling, the Robert S. Kerr Environmental Research Laboratory TSC also developed and hosted a workshop for academia, industry, and federal and state agencies to discuss the topic.

Superfund Technical Liaisons

Through the STL program, senior ORD scientists, are permanently stationed in Regional offices. The STLs provide direct technical assistance to Regional staff, facilitate interaction among ORD laboratories and Headquarter's offices, promote the application of good science within the Regional waste programs, and provide feedback to ORD on Regional technical needs.

Exhibit 4.5-4
START and ETSC Program Assistance
(Fiscal Year 1989 Through Fiscal Year 1993)



Source: Office of Research and Development.

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Ground-Water and Engineering Forums

The Ground-Water and Engineering Forums coordinated activities to address ground-water and engineering concerns encountered in site remediation. In addition to issue papers developed in conjunction with TSCs, the forums provided opportunities for members to conduct technical reviews of four guidance documents during the year. Seven forum members also joined the American Society of Testing and Materials to help review standards which relate to EPA's field protocols.

Expanding their interagency coordination, the forums held joint semi-annual meetings with the Department of Energy (DOE) and the U.S. Geological Survey. The semi-annual meetings improve technology transfer and aid in improving interagency communication and coordination.

4.5.3 Technology Transfer and Interagency Sharing

TIO is a widely recognized leader in the technology innovation arena. For more than four years, TIO has identified and cataloged information in many areas, including

- Trends in the use of innovative technology at Superfund, RCRA, and underground storage tank (UST) sites;
- Future markets for innovative remediation technologies;
- Procurement barriers to the use of innovative technologies;
- Support services for technology developers;
- Screening matrices for technologies; and
- Demonstrations of technologies at other federal agencies.

TIO has also brought federal agencies, academia, and the private sector together to demonstrate and evaluate technologies.

Innovative Technology Forums and Conferences

To encourage collaboration efforts between EPA, other Federal agencies, academia, and the private sector, EPA sponsored forums and conferences for exchanging information on innovative technologies. The Agency also participated in international efforts to exchange information on the technologies.

Through the Federal Remediation Technology Roundtable, TIO provides an information exchange network for federal agencies conducting applied research and development of innovative remediation techniques. The Roundtable published three documents on innovative technologies during the fiscal year: the first highlighting active federal demonstrations, the second describing federal databases available, and the third listing new federal publications on the subject. Interagency communication through the Roundtable also led to several joint initiatives to demonstrate technologies and document their cost and performance.

TIO and ORD organized the Remedial Technologies Development Forum (RTDF). The RTDF assists in encouraging collaboration among companies, public interest groups, states, universities, DOE, and the Department of Defense in defining, prioritizing, and funding clean-up technologies. By consulting on technologies at the earliest stages of their development, the RTDF seeks to combine the financial and intellectual resources of consortium members to promote research coordination and eliminate duplicative research and development. The Forum also plans to collaboratively demonstrate technologies at federal facilities.

Encouraging international exchange of information on clean-up technologies, EPA's OSWER and ORD served as project directors for the North Atlantic Treaty Organization's (NATO's) Committee for the Challenges to Modern Society pilot study, on the *Evaluation of Demonstrated and Emerging Remedial Action Technologies for the Cleanup of Contaminated Land and Ground Water*.

This study is the follow-up to a successful first-phase effort to share information on innovative treatment technologies. In the first phase, information on 29 soil and ground-water remediation projects was exchanged. The second phase is continuing this work for field-demonstrated technologies, while expanding the scope to include emerging processes in earlier stages of development. The development of uniform data-reporting methods to expand technology-transfer capabilities is also emphasized. Results from the initial study were accepted by the NATO Plenary and published by EPA. Fifteen countries actively participated in this program.

Efforts to Demonstrate and Evaluate Innovative Treatment Technologies

To encourage increased use of innovative treatment technologies, TIO worked during FY93 to improve documentation of cost and performance for innovative treament technologies. TIO also engaged in projects, such as the public/private partnership program, to demonstrate new technologies.

To "benchmark" innovative technologies, TIO worked to gather data on 17 completed Superfund projects that used innovative technologies for full-scale remedies. Coordinated through the Federal Remediation Technologies Roundtable, the project aims to standardize cost and performance reporting by other federal agencies engaged in similar efforts.

In the public/private partnership program, TIO, the Air Force, Clean Sites, and several technology end-users are collaborating to evaluate the cost-effectiveness of remediation technologies. The public/private partnership project is being conducted to evaluate technology applications, particularly for *in situ* processes, at federal facilities with contamination problems that are similar to those faced by the participating corporations at their own facilities. The partnership project is based on the premise that risk-sharing is a critical incentive to encouraging greater use of new technologies; PRPs often hesitate to risk the cost and potential liability of a failed test of a proposed technology at their site, and this hesitation slows commercialization. Using federal facilities as test locations is one of the government's major contributions to promoting new environmental technologies. This mutually beneficial arrangement reassures industry about using the technology and helps to defray the government's evaluation costs. A partnership project for joint testing and evaluation of technologies at McClellan Air Force Base has been scheduled.

Reference Materials

To encourage use of innovative technologies, the Agency provides a variety of reference materials on the technologies. The Agency maintains five electronic sources of information on innovative treatment technologies: the Vendor Information System for Innovative Treatment Technologies (VISITT) the Clean-Up Information (CLU-IN) electronic bulletin board the Alternative Treatment Technology Information Center System (ATTIC), ORD's electronic bulletin board system (BBS), and the RREL Treatability Database.

- VISITT contains vendor-submitted performance and cost information. As of FY93, VISITT 2.0 included information on 231 innovative treatment technologies offered by 141 developers and vendors. TIO provides this information on diskettes to interested potential users of innovative technologies. Since its initial development in FY91, TIO has distributed more than 10,000 copies of the system to requestors in over 50 countries.
- TIO funds and manages the CLU-IN electronic bulletin board, designed to serve project managers and others interested in information on innovative remediation technologies. This bulletin board offers a range of technology-related information that may be read on-line or down-loaded to a personal computer. In 1993, CLU-IN was enhanced to include *Federal Register* notices on hazardous wastes, a listing of EPA publications, a calendar of training programs, *Commerce Business Daily* "requests for proposals" for environmental clean-up work, and a directory of EPA experts on hazardous site clean-up.
- ATTIC, developed and implemented by ORD, integrates hazardous waste data in a centralized searchable source that may be accessed by federal,

state, and public sector users. It provides a mechanism for retrieving full-text documents of key literature. Databases that can be accessed through ATTIC include the treatment technology database, the tractability and study database, the UST database, the oil/chemical spill database, the Bioremediation in the Field Search System, and VISITT.

- The ORD BBS, which currently has over 8,000 registered users, is operated by the Center for Environmental Research Information in Cincinnati, Ohio. It was set up to improve communication and technology transfer among EPA staff, state and local officials and staff, researchers, and the private sector. One special feature of the ORD BBS is a text-searchable database of all ORD publications produced since 1976 (over 20,000 citations). Each citation contains the publication title, authors, sponsoring organization, abstract ordering information, and other information. The BBS can be used to send and receive messages, upload and download bulletins and files, and communicate recent ORD activities.
- The RREL Treatability Database was developed to provide a thorough review of the effectiveness of proven treatment technologies in the removal/destruction of chemicals in various types of media including, municipal and industrial waste water, drinking water, soil, debris, sludge, and sediment. The database contains information on more than 1,200 chemical compounds and over 15,800 sets of treatability data. The database has been distributed to approximately 2,800 organizations including federal, state and local governments, environmental groups, law firms, and engineering firms. The database can be obtained from RREL or from ATTIC.

TIO and ORD have also developed several publications and a display booth that provides information on new developments and applications of innovative treatment technologies:

- *Innovative Treatment Technologies: Annual Status Report* provides information on the selection and use of innovative treatment technologies at Superfund sites and provides technical background information. The September 1993 report contains information on almost 300 innovative technology projects at Superfund remedial and removal sites. The report is designed to enhance communication among vendors, experienced technology users, and those who are considering using innovative treatment technologies to clean up contaminated sites.
- *Tech Trends and Ground Water Currents* are two newsletters distributed by TIO on soil treatment technologies and ground-water remediation technologies respectively. These newsletters are published quarterly and distributed to over 12,000 interested subscribers, including federal and state project managers, consulting engineers, academia, and technology users.
- *Citizen's Guides to Innovative Treatment Technologies* is a set of 10 publications that provide community leaders and the public with basic, readable information on technologies that can be used to clean up Superfund, corrective action, or UST sites. Spanish-language versions of these guides were completed in FY93.
- *Selected Alternative and Innovative Treatment Technologies for Corrective Action and Site Remediation*, updated by TIO, bibliographs EPA information resources to assist technology users developers, researchers, and technology users in identifying publications related to remediation technologies.
- *Remediation Technologies Screening Matrix and Reference Guide*, developed by TIO and the Air Force, summarizes the strengths and limitations of innovative and conventional technologies for the remediation of soil, sediment, sludge, ground water, and emissions.
- *Bioremediation Resource Guide* directs readers to resource documents, databases, hotlines, and dockets. The purpose of the guide is to assist technology users in accessing information on bioremediation technology and its applications.

- TIO sponsors several traveling information booths. These displays, which are sent to hazardous-waste remediation conferences and other meetings around the country, are major outlets for dissemination of EPA materials and database information on innovative remediation technologies.

Training and Continuing Education

The Agency sponsored efforts to develop training resources and materials on technologies and site remediation:

- OSWER, in cooperation with the American Association of Environmental Engineers, continued work on the *Waste Monographs* that detail specific innovative technologies. These monographs will aid consulting engineers' and technology end users' understanding of state-of-the-art technologies. They contain design criteria and performance and cost information.
- EPA developed a series of satellite video conferences in coordination with the Air Force, Air and Waste Management Association, and the Hazardous Waste Action Coalition. The conferences were downlinked to over 70 sites nationwide and provided participants state-of-the-science information on selected innovative technologies.
- EPA developed a teaching outline and support materials for a one-semester course on innovative technologies for use by graduate engineering departments. The course was developed in conjunction with the University of Connecticut and the American Association of Environmental Engineering Professors. The course book, published in FY93, is entitled *Hazardous Waste Site Remediation: Source Control*.
- TIO in cooperation with the Office of International Activities developed the *Principles of Hazardous Waste Site Ranking* train-the-trainer course to provide basic environmental management information to the emerging democracies of Central and Eastern Europe. In 1993, TIO delivered training in Poland and began negotiations with the government of Bulgaria to begin training there. The primary objective of the training course is to assist the host government in developing programs to establish hazardous-site-remediation priorities. The training course helps participants identify potential threats to public health, welfare, and the environment; promotes effective use of limited resources and expertise; encourages public involvement and support in identifying and responding to waste-site problems; reassures those living near low-ranked sites that no immediate threat to their well-being exists; and ensures governmental accountability and consistency in program applications both nationally and internationally.

4.6 Report on Facilities Subject to Review Under CERCLA Section 121(c)

Certain remedies, such as containment remedies, allow hazardous substances, pollutants, or contaminants to remain on site if they do not pose a threat to human health or the environment. CERCLA Section 121(c) requires EPA to conduct a review of such sites at least every five years after the initiation of the remedial action to ensure that the remedy fully protects human health and the environment. CERCLA Section 121(c) also requires the Agency to submit a report to Congress that lists the facilities for which periodic reviews are required, the results of all the reviews, and any action taken as a result of the reviews. FY93 was the third year in which sites were eligible for five-year reviews. Exhibit 4.6-7 contains the list of sites where five-year reviews were required in FY93. In addition, the following FY92 five-year reviews were completed during FY93: Re-Solve, Inc (MA), Newport Dump (KY) for a total of six five-year reviews completed in FY93.

To define the scope of five-year reviews and identify two types of reviews that may be conducted, the Agency issued a directive entitled *Structure and Components of Five-Year Reviews*. The directive

Exhibit 4.6-1
Sites At Which Five-Year Reviews Are Required Under CERCLA Section 121(c), Fiscal Year 1993

Site Name (State)	Region	Review Date
Beacon Heights Landfill (CT)	1	
Charles-George Reclamation Trust Landfill (MA)	1	
Keefe Environmental Services (NH)	1	2/22/93
Piccillo Farm (RI)	1	5/19/93
GE-Moreau (NY)	2	
Avtex Inc. (VA)	3	
West Virginia Ordnance (WV)	3	
Harvey and Knott Drum Site (DE)	3	8/25/93
Tysons Dump #1 (PA)	3	
Independent Nail Co. (SC)	4	
Forest Waste Products (MI)	5	
IMC Terre Haute East Plant (IN)	5	
Northern Engraving Co (WI)	5	
Metamora Landfill (MI)	5	8/24/93
Mid-South Wood Products (AR)	6	
Petro-Chemical Systems Inc. (Turtle Bayou) (TX)	6	
Minker/Stout/Romaine Creek Site (MO)	7	
Syntex Facility-Verona (MO)	7	
John Deere (Dubuque Works) (IA)	7	
Anaconda Co. Smelter (MT)	8	
California Gulch (CO)	8	
Iron Mountain Mine (CA)	9	

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defines "statutory reviews" as those expressly required by CERCLA Section 121(c). "Policy reviews" are defined as discretionary reviews that the Agency may choose to undertake in circumstances where they are not required by CERCLA. To reinforce the five-year review directive, EPA issued a fact sheet in August 1991 on five-year reviews.

The FY93 policy reviews were conducted at Winthrop Landfill (ME), Plymouth Harlan/Cannon Energy Corp (MA), Western Sand and Gravel (RI), Kellogg-Deering Well Field (CT), Wade (ABM) (PA), Presque Isle (PA), Mowhray Energy Company (AL), Triana/Tennessee River (AL), Distler Farm (KY), Burlington Northern (MN), Oardale Dump Site (MN), Whittaker Corporation (MN), DesMoines TCE (IA), LaBounty Dump Site (IA), Aidex Corporation (IA), Waverly Ground Water Contamination (NE), Celtor Chemical Works (CA), United Chrome Products Inc. (OR), and Western Processing Company, Inc. (WA). A total of 19 policy reviews were completed in FY93.

At all sites where statutory and policy reviews were conducted during FY93, EPA determined that the remedies continue to protect human health and the environment. EPA will continue to conduct future five-year reviews consistent with CERCLA Section 121(c) and Agency guidance.